

Dung beetles as indicators of change in the forests of northern Borneo

Abstract

1. We reviewed the use of dung beetles as indicators of environmental change, highlighting the influence of natural forest dynamics on species distributions in primary forest and suggesting new ways in which this can be used to understand and interpret the effects of disturbance such as logging. These ideas were applied to rainforest dung beetle communities in Sabah, Malaysia.

2. Dung beetle samples, using baited pitfall and flight intercept traps, were examined from primary, logged and plantation forests. Cluster analysis on dung beetle assemblages from primary forest samples showed clear species associations that had a high degree of fidelity to a particular biotope or vegetation type. Beetles were grouped into riverine-edge, riverine, interior-primary and 'even' (equitable distribution between biotopes) associations. Although biotope-specific associations were spatially separate in primary forest, these associations overlapped at forest margins (riverine forest) and in logged forest (to form 'composite assemblages').

3. Species associations showed different responses to disturbance: the riverine association included many species that showed a positive response to at least some types of disturbance, whereas others were neutral or negative in response; the even association species were mostly neutral; the primary forest associations were almost entirely negative in response.

4. The greatest faunal similarities were found between logged forest and riverine assemblages. Diversity was lower in logged compared with primary forest, and the lowest species richness and diversity were recorded in plantation forest. Small-scale species richness in logged forest was generally higher than in individual transects from primary forest due to the presence of overlapping species ranges (composite assemblages) that were usually spatially separate in primary forest. Data suggested that increased species

richness at a fine scale does not necessarily mean that species richness is greater at a larger scale, and that species mixing in derived ecosystems is dependent on the type of disturbance. Forest management should aim to minimize the mixing of the components of different biotopes, by implementing low impact (i.e. reduced-impact logging) harvesting techniques.